ENERGY POVERTY

AN AGENDA FOR ALBERTA

R. Boyd and H. Corbett

All One Sky
FOUNDATION

Helping ALL people prosper in a changing climate

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Foreword:

The alleviation of poverty has been a major concern of mine throughout my career in the not-for-profit sector and as a City of Calgary councillor. People living in poverty are often overlooked in the design of environmental programs.

Those concerns led me to champion a proposal by All One Sky Foundation in 2013, to investigate the potential to incorporate energy efficiency in the upgrades of affordable housing in buildings owned by the Calgary Housing Company.

The resulting study, supported by a City of Calgary Council Innovation award, showed that energy efficiency improvements offer significant social, economic and environmental benefits to our most vulnerable citizens.

Since the study was tabled at City Council in 2014, All One Sky Foundation has attracted important community support to expand its work in energy poverty in Alberta. This report is the first attempt to quantify the number of energy poor in the province; describe its health, economic and environmental implications; and outline the necessary steps to address this overlooked issue.

I urge all levels of government to include energy poverty as an important strategy for sustainable poverty reduction.

Gael MacLeod

Calgary, Alberta

Key points:

- Families in Alberta spent $3.6 billion on home energy bills in 2013.
- The poorest households in Alberta face disproportionate energy costs. Low-income households spend, on average, seven times more of their disposable income on home energy services than the richest households.
- About 255,000 families (or 455,000 people) in Alberta live in energy poverty—that is roughly 1-in-6 households.
- Energy poverty refers to the inability of a household to maintain 'adequate' energy services at reasonable cost. By adequate, we mean a level of energy consumption in the home necessary to safeguard health and well-being.
- These families often face difficult choices between competing basic necessities such as energy, water, food and clothing. They are also vulnerable to ill health—both physical and mental—and increased mortality risk. The young, elderly, disabled and long-term sick are especially at risk.
- Poorly designed climate change mitigation and energy efficiency policy could increase the number of energy-poor Albertans.
- The most cost-effective and sustainable solution to energy poverty in Alberta is to increase the energy efficiency of energy-poor households over time, starting with those most in need. Complementary action should encourage behavioural change among the energy poor to reduce energy wastage, and provide energy bill support to vulnerable households still not achieving affordable energy services, or who have not yet received energy efficiency improvements to their homes. The success of these actions depends crucially on precise targeting of energy-poor households.
- A roadmap is needed to address energy poverty in Alberta—to develop shared goals; to decide the best solutions for energy-poor Albertans; to establish roles and responsibilities across government, market actors and the voluntary sector; and to assess the extent to which we are achieving our goals.

Summary:

There's a widespread form of poverty in Alberta that is rarely discussed. It is energy poverty, the inability of financially-strapped families to maintain adequate energy services at a reasonable cost.

About 455,000 Albertans live in energy poverty; that's about one in six households, or 255,000 households in total. These lower-income families spend some seven times more disposable income on home energy—heating, cooking and lighting—than the richest households and three times more than the average. For the lowest-income households, these costs average $1,700 a year, or more than 16 per cent of their disposable income.

The energy poor must often make difficult choices between competing basic necessities such as energy, water, food and clothing. The most dramatic choice for some is to "heat or eat." Indeed, evidence suggests the poorest households, especially among seniors, spend less on food in winter to pay for additional heating.

Energy poverty takes its toll on health and wellbeing, particularly among the young, elderly, disabled and those with long-term illnesses. Cold, damp homes can contribute to a wide range of respiratory and cardiovascular illnesses and health conditions including heart attack and stroke, reduced lung function, suppressed immune systems, asthma attacks and exacerbated arthritis. Living at cold temperatures is also associated with increased injuries in the home, stress, social isolation and, for children, impaired educational success.

Energy poverty thus results in increased public costs for health care and social services. One study suggests that every $1 spent on raising living temperatures to acceptable standards saves 42 cents in health-care costs.

Alberta's energy poor could also be disproportionately impacted by any changes to the provincial government's climate change policies. Such changes will likely lead to increased energy prices, hurting poorer households, who typically do not benefit from energy efficiency improvements and ironically emit fewer greenhouse gas (GHG) emissions than the norm. For example, the introduction of, say, a $30 per tonne carbon price would increase energy costs for all households, but the poorest households would see their disposable incomes fall six times more than the richest households.

The most cost-effective, sustainable solution to this problem is to increase the energy efficiency of energy-poor households, starting with those most in need. Such actions should recognize the reality that these households will be unable to improve the energy efficiency of their homes without substantial subsidies, delivered through precisely targeted local programs. Complementary action should encourage behavioural change to reduce energy waste and provide energy-bill support to the most vulnerable households.

A roadmap is needed to address energy poverty in Alberta. It should develop and assess shared goals as well as establish roles and responsibilities across government, market actors and the voluntary sector.

Tackling energy poverty in Alberta offers a potential win-win-win for three important environmental and social policy agendas: climate change mitigation and GHG reduction; health and wellbeing; and poverty alleviation.

1 Defining the Problem

The Concept of Energy Poverty and its Origins

The term energy poverty describes a problem by which a combination of poor housing conditions, low income and rising energy prices means that a household cannot afford adequate energy services (for heating, cooking, lighting, etc.) to meet its health and well-being needs. The term first emerged on the policy scene in the United Kingdom (UK) in the mid-1970s. Rapidly rising energy prices, as a consequence of the 1973-74 oil crisis, created serious difficulties for households on fixed, low incomes, and particularly for those residing in energy-inefficient homes that are expensive to keep warm.

One of the main concerns was the detrimental effect of cold homes on health. Living in a poor-quality, cold home is linked with ill health—both physical and mental—and increased mortality risk. The young, elderly, disabled and long-term sick are especially vulnerable to these effects.

"*Fuel poverty is a recognized social problem that affects the poor, with its roots in the quality of housing and cost of fuel.*" [Boardman, 2010]

While living in cold homes (and the resulting health effects) is an obvious manifestation of energy poverty, the problem has wider implications. For instance, energy poverty also has an important environmental aspect. Actions to alleviate energy poverty can contribute to wider efforts to combat climate change. Improving the energy efficiency of the housing stock is a necessary component of any cost-effective strategy to reduce greenhouse gas (GHG) emissions. Energy-poor individuals and families tend to live in energy-inefficient dwellings, which are, per square meter, the most polluting. Hence, actions to take households out of energy poverty by improving the energy efficiency of their dwellings, will also contribute to efforts to combat climate change. At the same time, poorly designed climate change policies can impose inequitable and disproportionate costs on financially-disadvantaged households.

Since energy poverty first emerged as a concept 40 years ago, it has gained increasing recognition as a cross-cutting policy issue, with implications for poverty alleviation, health and well-being and climate change strategies.

Measuring Energy Poverty

While there is widespread agreement at a conceptual level that energy poverty refers to the inability of a household to maintain adequate energy services at reasonable cost, operational definitions of energy poverty can differ markedly in their construction, with significant implications for effective policy formulation: for measuring the extent and depth of energy poverty, for understanding the composition of the energy poor, for targeting action at those who need it most, and for monitoring progress.

"*…unless we properly understand the problem, we cannot design effective solutions.*"

[Edward Davey, UK Secretary of State for Energy and Climate Change]

Professor Brenda Boardman's landmark book of 1991 provided the first operational definition for measuring energy poverty: a household was considered energy poor if annual spend on all energy services exceeded 10 per cent of its income. At that time, this was what the poorest 30 per cent of households in the UK were spending on energy services for the home and, at twice the expenditure of the median household, was a threshold above which spending on energy was judged to be 'disproportionate'.[1] This threshold was subsequently adopted by UK governments, and underpinned their energy poverty strategy for more than a decade. However, rather than measuring energy costs on the basis of

[1] Median is the middle number in a pool of numbers. For example, if the median income in a pool of 100 people is (say) $65,000, it means that exactly 50 people reported incomes greater than or equal to $65,000 and exactly 50 people reported incomes less than or equal to $65,000.

actual expenditures, they were instead based on the modelled energy costs required to achieve thermal comfort levels that safeguard health—resulting in the energy poverty ratio shown in Box 1. With the revised definition, the intention was not to measure whether households in fact were spending more than 10 per cent of their income on energy services, but rather whether they would need to do so in order to maintain a 'satisfactory' heating regime, defined on the basis of observed income data and energy consumption modelled on the physical characteristics and thermal efficiency of typical (archetype) dwellings.

Measuring energy costs on the basis of modelled spend as opposed to actual spend, has the significant advantage of capturing observed under-consumption by low-income households. Survey data consistently shows that low-income households substantially under-spend on energy—forgoing a heating regime necessary to safeguard health and well-being in order to meet the costs associated with other basic necessities.

Energy poverty is a distinct problem to the more general challenges of income poverty, requiring focused attention because:

- Not all low income households are energy poor (e.g., some low income households will live in energy efficient dwellings that are cheaper to heat and power);
- It is linked with particular illnesses and health conditions that have more acute impacts than the more chronic outcomes associated with income poverty;
- Actions to tackle energy poverty are not just income-related—improving the energy efficiency of dwellings is the main strategy to alleviate energy poverty;
- Capital expenditures—for example, to improve the energy efficiency of dwellings—can have a major impact on reducing energy poverty, while addressing general income poverty typically involves government transfer payments; and
- Actions to address energy poverty will generally effect change more rapidly than actions to address income poverty.

Source: Hills (2012)

Box 1: Energy Poverty Ratio

$$\text{Energy poverty ratio} = \frac{\text{Required energy costs (modelled energy requirements x price)}}{\text{Income}}$$

A household with an energy poverty ratio equal to, or in excess of, 0.10 (10 per cent) is classified as energy poor.

The ratio may also be used to define degrees of energy poverty, for the purpose of prioritizing action. For example, a household with a ratio between 0.13 and 0.20 could be classed as severely energy poor; a household with a ratio greater than 0.20 could be classed as extremely energy poor. Equally, a household with a ratio between 0.08 and 0.10 could be classed as marginally energy poor.

Two key assumptions underpinning the use of the energy poverty ratio relate to measuring income and estimating required energy costs. A further issue relates to the use of a fixed or absolute threshold, such as 10 per cent of income. Some important considerations relating to these issues are highlighted below, though no attempt is made to resolve them in this paper.

Measuring incomes:

Statistics Canada reports three measures of 'household' (or family) income:

- **Market income** (also called income before taxes and transfers) is the sum of earnings (from employment and net self-employment), net investment income, private retirement income, and other private income;
- **Total income** (also called income before tax, but after transfers) is market income plus all government transfers, but before the deduction of federal and provincial income taxes.
- **After-tax income** (or income after tax) is total income less income taxes.

Whether a low-income household can actually afford the required energy costs for their home will depend on net (disposable) income. This suggests that 'after-tax income' is the appropriate measure of income to use in the calculation of the energy poverty ratio.

By the same logic, a case can be made to omit housing costs from income—specifically, for the principle residence. A household cannot spend major fixed housing costs (e.g., rent, mortgage, insurance, HOA, property tax, etc.) on energy services, any more readily than they can so spend income tax, which is excluded from disposable income. These housing costs are often (and especially for low-income households) non-discretionary and therefore do really not constitute disposable income.

In poverty analysis, income is often adjusted ('equivalized') to enable a fair comparison between households with different sizes and compositions; a larger household needs a higher income than a smaller household to achieve the same standard of living, but not in a proportional way due to economies-of-scale in consumption. Statistics Canada uses a square root scale to calculate adjusted incomes—dividing household income by the square root of the household size and assigning this value to all persons in the household. In effect, a household of (say) four persons is assumed to have needs twice as large (and not four times as large) as one composed of a single person. Some argue that equivalized incomes should be used in the calculation of the energy poverty ratio. This has also led to arguments for similar adjustments to required energy costs. The case for either adjustment is not unequivocal.

	Market income
+	*Government transfers*
=	**Total income**
-	*Income taxes*
=	**After-tax income**
-	*Fixed housing costs*
=	**Net (disposable) income**
÷	*Square root of house size*
=	**Equivalized net income**

A final issue relating to the determination of income relates to which government transfer payments to include or exclude. For example, how should disability-related benefits be treated? The purpose of such benefits is to meet the additional costs associated with disability. Including them in the calculation of income overstates the sufficiency of a disabled person's income to meet their required energy needs, since such benefits are not available to meet these needs. Questions have also been raised over the appropriate treatment of housing-relating benefits within income.

How different measures of income affect the calculation of the energy poverty ratio is highlighted in Table 1.

What constitutes an appropriate measure of income for energy poverty analysis? Should income be measured before or after fixed housing costs? Whether using before or after housing costs, should incomes be equivalized? Which government transfers should be included within income?

Table 1: The Effect of Different Measures of Income on the Energy Poverty Ratio, by Income Quintiles for Alberta

Income measure	Lowest	Second	Third	Fourth	Highest
Market income	15.1%	6.4%	4.0%	2.8%	1.6%
Total income	8.8%	5.1%	3.7%	2.6%	1.5%
After-tax income	9.2%	5.6%	4.2%	3.1%	2.0%
Net (disposable) income	16.2%	7.6%	5.3%	3.7%	2.2%
Equivalized net income	20.5%	11.7%	8.5%	6.4%	4.0%

Note: Energy costs used in the calculations are surveyed expenditures (for the average household) on electricity, natural gas, and other fuels used in the home; they are **not** modelled costs to achieve a 'satisfactory' heating regime. Hence, the ratios shown likely understate the size of the problem, especially for the low-income households in the first quintile who likely consume less than required for adequate thermal comfort. Data are for 2011-12. **Source:** Author's own calculations.

1.6 times the second quintile

2.2 times the third quintile

3.0 times the fourth quintile

4.6 times the highest quintile

… how much more *after-tax income* an average household in the poorest income quintile in Alberta spends on home energy services.

Measuring required energy costs:

The calculation of the energy poverty ratio should ideally be based upon modelled energy costs required to maintain a 'satisfactory' heating regime, to account for observed under consumption by low-income households. But what is a satisfactory heating regime?

A substantial body of evidence supports a relationship between dwelling temperatures and health effects (see Section 2). The incidence of adverse health outcomes increases disproportionately at low (and high) temperatures, generally cited as outside the range of 18-24°C. However, within this range of 'acceptable' values for comfortable living, what constitutes a suitable threshold of thermal adequacy is less clear. For example, in England the threshold for the primary living area across all dwellings is set at 21°C, and 18°C for secondary living areas, such as bedrooms. Some jurisdictions modify the temperature threshold (e.g., from 21°C to 23°C) and demand patterns (e.g., from 9 hours to 16 hours per weekday) for vulnerable households—e.g., with members aged 60 or over or with long-term illness or disability. Energy demand can also be adjusted for under-occupancy (e.g., assuming that only a fraction, say half, an 'under-occupied' dwelling is heated). All these factors, and more, will obviously affect modelled energy requirements. Appropriate assumptions will need to be established for any application in Alberta.

What constitutes a suitable temperature threshold for a 'satisfactory' heating regime in Alberta? Should a different threshold (and demand pattern) be used for the most vulnerable households? Should adjustments be made to energy demand patterns for under-occupied dwellings?

Further consideration will need to be given to the choice of energy prices for modelling purposes, and specifically the extent to which the use of averaged prices is inappropriate for low-income households. Prices may vary significantly by, among other things, the location of households within the province, the choice of supplier, the choice of tariff, and the method of payment.

What are the most appropriate energy prices to use when estimating required energy costs? What is the best source of this information?

While the focus of this paper is energy poverty, several experts suggest that the affordability of water—another utility service vital to health and well-being—should be part of the same discussion. In 2011-12, the average household in the lowest income quintile spent about $1,700 annually on home energy services. This represents 9.2 per cent of after-tax income. With the inclusion of water services, total annual spend on all utilities increases to about $2,200 for the average household. Expenditure on all utility services now consumes roughly 11.9 per cent of after-tax income. The average low-income household is thus spending 4.7 times more of its after-tax income on home utilities than the average household in the highest income quintile.

Should the cost of water services be added to required energy costs to create an indicator of total utility cost burden?

Absolute or relative energy poverty:

The operational definition of energy poverty originally proposed by Boardman in 1991 labeled households as energy poor where their actual expenditure on home energy services exceeded 10 per cent of their income. This threshold represented twice the concurrent expenditure of the median household and reflected the expenditure on energy services by the poorest 30 per cent of households at that time (in 1988).

The 10 per cent threshold was intended to be relative to both the energy bill and income of the median household at a particular time. In practice, however, it has remained constant over time, with jurisdictions using the 10 per cent value year-after-year-after-year. Whether a household is classed as energy poor or not is thus dependent on its required energy costs and income compared with median values in 1988 (and in the UK), rather than being relative to the financial circumstances and energy use patterns of contemporary households. In other words, the measurement of energy poverty has been absolute, and not relative to actual energy expenditures by typical households in a specific year. Consider the values in Table 1, for example. In 2011-12, households in Alberta could be classed as energy poor if they had an energy poverty ratio equal to, or greater than, 8.4 per cent, on an after-tax income basis (i.e., twice the ratio of the average, though not median, household in the middle income quintile).

Some experts have argued that the definition of energy poverty should be a relative rather than an absolute one. The case for use of a relative measure is, nevertheless, far from conclusive.

Should the threshold for energy poverty be determined relative to the median energy cost to income ratio for all households, with its value changing over time, or be a fixed, absolute threshold, such as 10 per cent of income?

The Extent of Energy Poverty in Alberta

Can we say anything about the extent of energy poverty in Alberta? For a start, the home energy burden of an average low-income household is clearly disproportionate relative to the burden experienced by other households in the province, irrespective of the income measure used (see Table 1). As a fraction of net (disposable) income, an average low-income household in 2011-12 spent over seven times more on home energy services than an average household in the highest income quintile; and over three times more than the average household in Alberta. The inequality is worse than the data in Table 1 shows, given that low-income households will tend to consume less energy than required to maintain adequate warmth—instead diverting their limited disposable income to other basic necessities.

Over 2011-12 average home energy costs in the lowest income quintile are about $1,700 per year, or 9.2 per cent of after-tax income for the average household in this group. Average household shelter costs (of which energy costs typically represent about 15 per cent) across the lowest income quintile consistently exceed median shelter costs (i.e., what half the households spend). It therefore seems reasonable to assume that slightly less than half of the 318,000 households in the lowest quintile face energy burdens of 9.2 per cent. So, it seems reasonable to assume that about 60 per cent (or 190,000 of 381,000) of households may face energy burdens in excess of 8.4 per cent—the contemporary threshold for classifying households in Alberta as energy poor defined above. For the second income quintile, energy costs for the average household are about $2,250 or 5.6 per cent of after-tax income. For this group, it seems reasonable to assume that approximately 20 per cent, or 65,000 of 318,000 households, could be spending 8.4 per cent or more of their after-tax income on energy services. This suggests, conservatively, that about 255,000 households (or 455,000 people) in Alberta are energy poor—that is roughly 1-in-6 households.

255,000 households (or 455,000 people) in Alberta may be considered energy poor—that is roughly 1-in-6 households

This correlates reasonably well with the number of households in the province which might be considered eligible for low-income energy assistance in other jurisdictions in North America. Most jurisdictions in Canada and the U.S. operate and fund special energy efficiency and conservation programs for low-income households. Eligibility to participate in these programs is governed by various definitions, but a household is typically eligible if it has a household income less than 30-50 per cent of the median household total income (about $72,800 in Alberta in 2011-12). Applying these criteria to Alberta means that approximately 235,000 to 345,000 households would be considered eligible for low-income energy assistance.

Clearly, a significant number of Albertans are energy poor and stand to benefit from action to alleviate high energy burdens.

The Most at Risk

There is no doubt that certain groups in Alberta are more likely than others to find themselves suffering from energy poverty. Knowing these groups is crucial for prioritizing action. For instance, in other jurisdictions, older people (particularly those living on their own, in larger privately-owned homes) are observed to suffer severe energy poverty. Policy-makers may wish to consider actions that target this group.

Characteristics of the poorest 20 per cent of households in Alberta in 2011-12:

- **$18,600** is the average after-tax household income.
- **1.6** persons is the average household size.
- **50%** are homeowners.
- **82%** have no full-time earner.
- **64**% are lone-person households.
- **34%** contain adults aged 65 years and older.

Identifying the energy poor will depend largely on the exact definition of energy poverty adopted—different definitions will identify different target groups. Determining who is energy poor in Alberta will require analysis of energy poverty across a range of dwelling and socio-economic characteristics, including:

Socio-economic characteristics:

- Household income;
- Age of household occupants;
- Family types;
- Existing illnesses and long-term conditions (physical and mental);
- Disabilities; and
- Ethnicity.

Dwelling characteristics:

- Age of dwelling;
- Tenure;
- Type of dwelling;
- Size of dwelling;

- Energy efficiency of dwelling;
- Rural or urban; and
- Off-grid or grid connected.

Who are most at risk to energy poverty in Alberta? Who are the severe and extreme energy poor?

2 Effects of Energy Poverty on Health and Well-Being

"*People with lower incomes tend to have less favorable health outcomes than do people with higher incomes.*"

[Tjepkema, et al, 2013]

"*Health researchers have demonstrated a clear link between income and socio-economic status and health outcomes, such that longevity and state of health rise with position on the income scales.*"

[Jackson, 2009]

There is a substantial and growing body of evidence globally that shows a strong association linking cold and damp homes, energy poverty, and the health and well-being of individuals and households. The evidence relates to pre-mature mortality (the vulnerability of death) and morbidity (illnesses and diseases), as well as wider social impacts that living in a cold home may cause for both children and adults.

When considering the evidence, it is important to note that energy poverty and cold housing are used synonymously, with the majority of the evidence linking poor health and well-being outcomes to living at low temperatures and not to energy poverty per se. But there is compelling evidence that the drivers of energy poverty (the interaction between low income and high utility bills) are strongly associated with living in low temperatures.

The link between living at cold temperatures and detrimental health outcomes is well established. The World Health Organization (WHO) recommends that indoor temperatures are kept above 18°C with increases of 2-4°C for vulnerable groups (e.g., elderly, long-term sick and disabled). There are also other critical temperature thresholds at which detrimental health effects occur (see Figure 1).

Direct Physical Health Effects

The direct physical health effects of energy poverty and living at cold temperatures include:

Cardiovascular disease:

At living temperatures below 12°C blood vessels can constrict, resulting in a rise in blood pressure. This can lead to heart attack and stroke—especially in older people.

Respiratory illnesses:

Exposure to cold living temperatures reduces lung function, increases constriction of the airways (stimulating mucus production), and suppresses the immune system. These are all risk factors for triggering asthma attacks, pneumonia, and chronic obstructive pulmonary disease (COPD), such as emphysema and chronic bronchitis.

In addition, cold homes are more likely to be damp. This encourages the growth of mold, which can cause and aggravate respiratory illnesses. Children are particularly vulnerable to significantly increased risk of coughing and wheezing, and asthma attacks.

Energy-poor individuals and families tend to spend more time indoors where they are more likely to be in close proximity to one another (see below). This can aid the spread of contagious illnesses, such as influenza. Furthermore, living in cold temperatures can delay recovery from these illnesses.

Main health and well-being impacts of energy poverty and cold housing on different groups:

Children

- Reduced weight gain
- Increased hospital admission rates
- Impaired long-term development
- Worsening asthmatic symptoms
- Lower educational attainment

Adolescents

- Increased risk-taking behaviour
- Lower educational attainment

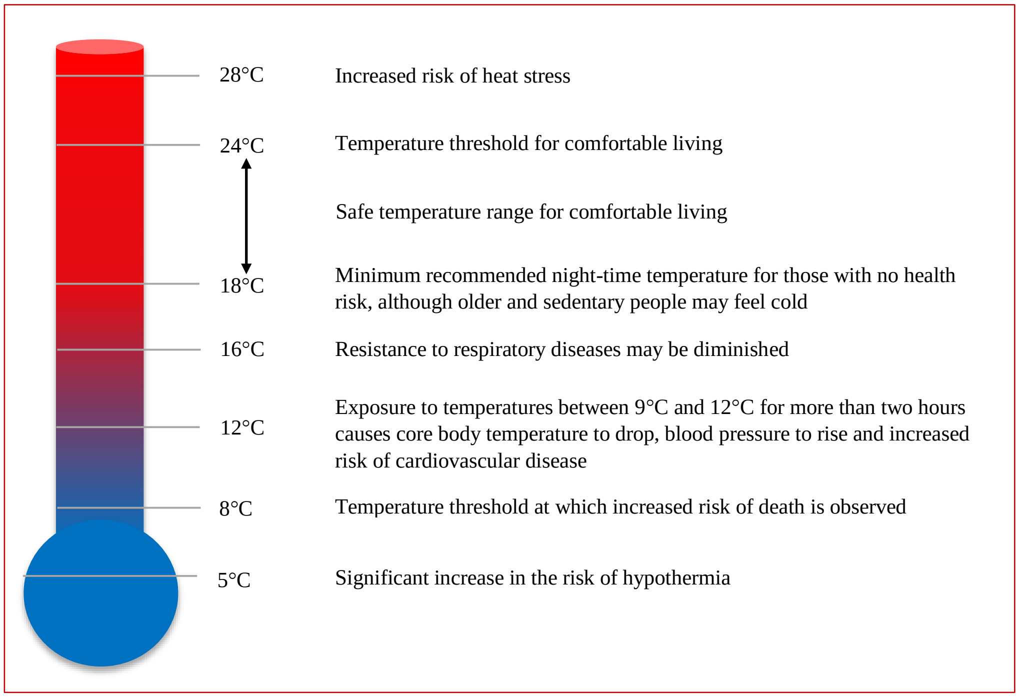
Adults

- Increased circulatory and respiratory illnesses
- Increased common mental health disorders

Elderly

- Higher mortality risk
- Increased circulatory and respiratory illnesses
- Greater risk of unintentional injuries
- Increased common mental health disorders
- Increased social isolation

Figure 1: Comfort and Health Effects of Exposure to Varying Living Temperatures



Source: Derived from WHO (2007), Geddes, et al. (2011)

Low weight gain in infants:

There is a relationship between living in cold homes and poor weight gain in infants, attributed to the fact that infants living in colder homes need greater calorific intake to keep warm and maintain normal growth and development. Detrimental effects on child development are long-term and may not be reversed in adulthood.

Hospital admissions for infants:

Infants living in colder homes have been observed to be at greater risk of admission to hospital or primary care facilities than the general population.

Unintentional injuries:

Living in cold homes affects mobility and increases the likelihood of unintentional injuries, primarily because: • symptoms of arthritis and rheumatism worsen in cold, damp homes; and • strength and dexterity decrease as temperatures drop, increasing the risk of accidents. The elderly are particularly vulnerable to injuries from falls.

Does the evidence in Alberta support the presumption of a link between energy poverty and poor health outcomes, including cardiovascular diseases and respiratory illnesses?

Deaths:

Living at cold temperatures has been linked to fluctuations in seasonal mortality rates—specifically, excess winter deaths. Indeed, excess winter deaths were one of the primary concerns when the phenomenon of energy poverty first emerged in the UK in the 1970s.

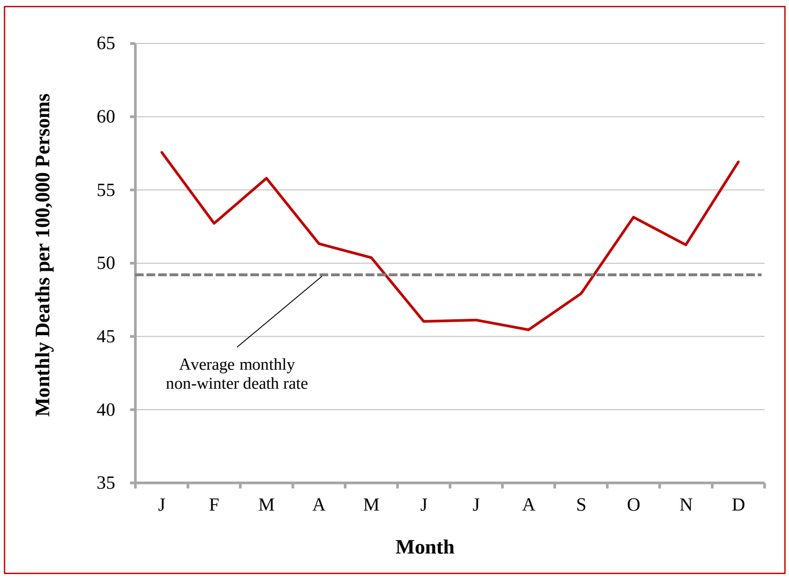
Figure 2 shows monthly death rates for Alberta over the period 1991-2011.[2] The data reveals a pattern consistent with the presence of excess winter deaths, with higher death rates in winter months compared to non-winter months. The average monthly death rate during non-winter months is 49 deaths per 100,000 persons. The monthly death rate is 14 per cent higher (or 56 deaths per 100,000 persons) during winter months. This translates into just over 1,000 excess winter deaths per year in Alberta.

Excess winter deaths are seasonal variations in deaths, defined as:

The difference between the number of deaths which occurred in winter (December to March) and the average number of deaths during the preceding four months (August to November of the previous year) and the subsequent four months (April to July of the current year).

[UK Office of National Statistics]

Figure 2: Fluctuations in Seasonal Mortality Rates in Alberta (Median Monthly Deaths per 100,000 over the period 1991-2011)



Source: Author's own calculations

Exposure to extreme cold can kill directly through hypothermia. However, this is not the main cause of cold-related death. In the UK, where excess winter deaths have been studied extensively, circulatory diseases (including heart attack and stroke) account for 40 per cent of excess winter death; a third are caused by respiratory illnesses. Deaths directly attributed to influenza or hypothermia account for only a small fraction of excess winter deaths, though influenza compounds the risk of death from circulatory and respiratory illnesses in winter. Of note, living in cold homes is believed to be a significant contributing factor to the increased incidence of respiratory and circulatory diseases during winter months.

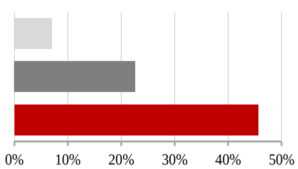
Does the evidence in Alberta support the presumption of a link between energy poverty and excess winter deaths?

[2] Seasonal death rates are sourced from CANSIM Table 102-0502, Canadian Vital Statistics, Death Database, Statistics Canada, Ottawa.

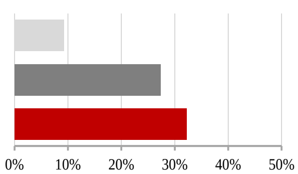
Where excess winter deaths have been studied, the largest single group affected is the over-65s. For the last 20 years in the UK, this group has accounted for over 90 per cent of excess deaths. The over-85s are worst affected. Similar analysis has not yet been performed on excess winter deaths in Alberta. Nonetheless, closer inspection of annual mortality statistics by age group for Canada reveals that cardiovascular and respiratory diseases (the leading causes of excess winter deaths) are among the top three leading causes of death among elderly people. It therefore seems reasonable to presume that the over-65s are also the single most vulnerable group to excess winter deaths in Alberta.

Top three leading causes of death (percentage of all deaths) in elderly Canadians in 2011:

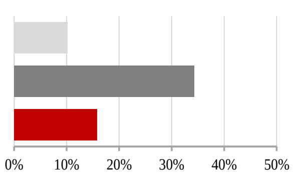
65-74 year olds



75-84 year olds



85+ year olds



Circulatory diseases
Respiratory illnesses
Cancers

Source: Statistics Canada

Are the affected over-65s also energy poor? On the basis of available data, all we can say is that the poorest 20 per cent of Canadians over 65 are at significantly greater risk of death from cardiovascular and respiratory diseases, compared to the richest 20 per cent (see Table 2). Whether the affected poorest people are also energy poor is unknown, and relates to the targeting questions we touched upon in Section 4.

Table 2: Ratio of (Age-Standardized) Mortality Rate for Poorest Canadians Compared to Richest Canadians (1991-2005)

Age	Cardiovascular Diseases		Respiratory Diseases	
	Male	Female	Male	Female
25-44 years	2.3	2.9	5.0	5.8
45-64 years	2.3	2.8	4.2	3.8
65-74 years	1.6	1.5	2.3	1.9
75+ years	1.2	1.1	1.5	1.2

Note: Ratios are calculated by dividing the age-standardized mortality rate for Canadians in the lowest income quintile by the age-standardized mortality rate for Canadians in the highest income quintile. Ratios greater than 1.00 indicate increased mortality risk. **Source:** CANSIM Table 102-0601, Statistics Canada.

Who are most at risk to excess winter deaths in Alberta? Does the evidence in Alberta support a link between excess winter deaths and the socio-economic status of these individuals or other indicators of social deprivation?

Beyond Direct Physical Health Effects

The environment in which people live and how they feel about it unquestionably has an impact upon their mental and emotional well-being. It is therefore not surprising that energy poverty and living at cold temperatures is linked with a number of direct detrimental effects on the mental health of all age groups.

Common mental disorders:

Households living at low temperatures are more likely to be stressed. The cold causes physical discomfort directly, which can be distressing, and high stress levels increase the risk of common mental disorders like anxiety and depression.

Heat or eat:

Energy poor individuals and families may trade off other necessities to keep warm, the most dramatic of which may to "heat or eat". There is evidence that the poorest households (and in particular the over-65s) reduce expenditure on food to pay for additional heating in winter. Not only is this linked to poor nutrition, but the trade-offs are also a source of stress.

Compounding matters, stress, anxiety and depression all lower people's capacity to resist other cold weather-related illnesses, leading to a vicious circle of health risks.

Energy poverty and the day-to-day experience of living in cold housing can also indirectly affect people's mental state by influencing their lifestyle choices, the opportunities available to them and their relationships with others. The main indirect mental health-related effects are:

Risk-taking behaviours:

People living in energy poverty may only heat a limited number of rooms (e.g., the living room). This can lead to overcrowding and a feeling of being "unhappy with family life". This is associated with various risk-taking behaviours (early alcohol and tobacco use) and trouble with the police among adolescents, as they seek privacy outside the home.

Energy-poor households are also more likely to turn to unsafe heating practices—e.g., heating their home with an open oven door or (faulty) electric heater. Supplemental heating has been linked to a significant number of residential fires and deaths in the United States each year. It is also associated with detrimental health effects due to exposure to poorer indoor air quality.

Interviewer:

"*If you are cold in your house, what effect does that have on your life in general*?"

Edwin, single middle-aged:

"*It makes you feel depressed, very much so.*"

[Harrington et al, 2005]

Educational attainment:

Increased duration of living at cold temperatures is associated with detrimental effects on children's learning as a consequence of having no warm and quiet place to study or the need to take time off school due to cold-related illness. Affected children are also more likely to be skip school or be suspended from school.

Social isolation:

Living at cold temperatures is linked to social isolation among adults. There is a social stigma attached with living in cold, poor-quality housing, which makes people reluctant to invite friends and family into their home. The same people will also have limited options for going out due to reduced disposable income. Even if going out was possible, during winter months they fear returning home, already feeling cold from being outside. Increased social isolation can adversely affect mental health and well-being; social isolation is a risk factor for depression.

Interviewer:

"*If you're cold in your own home, what effect has that on your life in general*?"

Evelyn, middle-aged couple:

"*Terrible. Sometimes we go to bed at 7 o'clock, and all our regular visitors know it is pointless coming after that time because they know where we are. We find it easier to go upstairs to sit underneath the blankets to keep warm.*"

[Harrington et al, 2005]

Is there evidence of a link between factors associated with energy poverty (living in cold homes, difficulty in paying energy bills) and poor mental health and social outcomes in Alberta? Which groups are most at risk?

The Health Economic Case for Tackling Energy Poverty

The impact of the above health effects on the welfare and life chances of individuals and families is reason enough for trying to ensure that energy-poor households can (and do) keep warm at reasonable cost. Energy poverty also has significant implications for health and social services. Impacts on the health sector include effects on:

- Primary care;
- Hospital services;
- Emergency services; and
- Community and social care.

Until the extent of energy poverty in Alberta is better understood, we cannot estimate the cost burden for Alberta Health Services. To provide some perspective nevertheless, the annual cost to the National Health Service in the UK of diseases and illnesses caused and exacerbated by cold homes is about $2.7 billion (representing about 1.2 per cent of the Service's total annual budget). Note that this figure does not include additional spending incurred by social services, or economic losses through missed work.

It has also been estimated that for every excess winter death there are eight hospital admissions and 100 consultations with a general practice doctor. Even if one-fifth of the estimated 1,000 excess winter deaths annually in Alberta were attributed to living in cold homes, that would equate to an additional 1,600 hospital admissions and 20,000 visits to the doctor's office.[3] The corresponding primary and secondary care costs for Alberta Health are about $15.8 million per year.[4]

Clearly, there is a potentially strong health economic case for tackling energy poverty in Alberta. Indeed, one cost-benefit study suggests that investing $1 to raise living temperatures to acceptable standards saves 42 cents in health services costs. Economic benefits beyond those directly related to avoided health service costs are also relevant, such as those arising from improvements to quality of life, reduced forgone economic output, etc. It is important that these broader social benefits are included within cost-benefit studies.

What is the cost burden of energy poverty for Alberta Health Services?

3 Impact of the Transition to Low-Carbon Economy

Alberta's Response to Climate Change

No challenge poses a greater threat to our planet, our economy, and our way of life than climate change. Average global temperatures have increased by 0.85°C since the late 1800s. The last three decades were the warmest 30-year period of the last millennium, and 14 of the 15 warmest years on record have occurred since 2000. The best scientists in the world tell us that this observed warming is very likely due to emissions of carbon dioxide and other greenhouse gases (GHGs) from human activities—scientists noticed that steady increases in global temperatures are correlated with increasing concentrations of carbon dioxide in the atmosphere. The same scientists warn that unless we take action to significantly curb GHG emissions, we will see increasingly more intense rainfall events and

[3] About one-fifth (21.5 per cent) of excess winter deaths annually in the UK are attributed to living in cold homes (Geddes, et al., 2011).

[4] The typical cost of visiting a general practice doctor in Alberta is assumed to be $71 per consultation (Alberta Health Care Insurance Plan, as of 04.01.2015). The volume-weighted average cost of a hospital admission for over-60s in Alberta for circulatory and respiratory illnesses is assumed to be $9,000 (Canadian Patient Cost Database, Canadian Institute for Health Information).

flooding, ice and snow storms, hail storms, wind storms, wildfires, drought and increased strain on water resources, and longer periods with uncomfortably high temperatures.

As a global citizen, Alberta has a responsibility to contribute to international efforts to curb GHG emissions and address climate change. The 2008 Climate Change Strategy committed Alberta to achieving GHG emission reduction targets by 2020 and 2050. Through a combination of action to advance carbon capture and storage, improve energy efficiency and green energy production, the Strategy sought to stabilize growth in GHG emissions by 2020 and thereafter deliver a 50 per cent reduction in 'business-as-usual' emissions by 2050—the latter equivalent to a 14 per cent reduction compared to 2005 levels.

The main policy tool to deliver emission reductions in Alberta is the Specified Gas Emitters Regulation (SGER), which requires large industrial facilities that emit more than 100,000 tonnes of GHGs annually to reduce their emissions intensity (i.e., emissions per unit of production). Specifically, these large industries are required to reduce their emissions intensity by 12 per cent below an agreed historical baseline. Put another way, each facility may continue to emit up to 88 per cent of its historical emissions intensity. Regulated facilities have several options for achieving their targets, including paying a charge (currently set at $15 per tonne $CO_{2\text{-equivalent}}$) into a technology fund for each tonne of GHG emitted in excess of the target.[5] A regulated facility that chooses to meet its target by only paying into the fund will thus face an average carbon price of up to $1.80 per tonne $CO_{2\text{-equivalent}}$ (i.e., 12 per cent of emissions at $15 per tonne $CO_{2\text{-equivalent}}$). By comparison, the carbon tax in British Columbia means that consumers face an average carbon price of $30 per tonne $CO_{2\text{-equivalent}}$ when they use fossil fuels. A higher carbon price will provide a stronger financial incentive for emitters to reduce their emissions, other things being equal.

In June 2015 the Alberta government updated the SGER. Regulated facilities are now expected to cut their emissions intensity by 20 per cent by 2017. In addition, the charge for any emissions that exceed their target will double by 2017 to $30 per tonne $CO_{2\text{-equivalent}}$. This will increase the average carbon price faced by large industrial facilities in Alberta to about $6 per tonne $CO_{2\text{-equivalent}}$. The government also announced a sweeping review of Alberta's climate change policies, to be completed by December 2015.

Balancing Social and Environmental Objectives

"*Our* [climate change] *plan must deliver on both environmental and social outcomes as Alberta transitions toward a lower-carbon future*."

[Shannon Phillips, Minister of Environment and Parks, Climate Leadership, Discussion Document, August 2015]

Transitioning to a low carbon society will have obvious near- and longer-term economic, health and environmental benefits for Albertans. But concerns exist over whether the deep reductions in GHG emissions required by mid-century can co-exist with a socially just approach that seeks to protect low-income households from inevitably higher energy prices. Even though reducing GHG emissions and energy poverty alleviation are intricately linked goals, they have remained relatively disconnected fields of policy development in Alberta. This disconnect means that possible synergies and trade-offs between both these fields are not given due consideration by policy-makers. As a consequence, individuals and families at the bottom of the income scale in Alberta may face a triple injustice: low-income households emit the least, pay relatively more, and benefit the least. This has important implications for the distributional impacts of climate change policies. Where policies invariably increase energy prices, the impact is likely to be detrimental for low-income households.

[5] Carbon dioxide equivalents are used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). The carbon dioxide equivalent for a gas is derived by multiplying the tonnes of the gas by the associated GWP.

Triple social injustice:

- ….. despite having the lowest energy consumption and GHG emissions
- ….. the poorest 20 per cent of households in Alberta would contribute proportionally more towards policy costs
- ….. while also benefitting the least from policies to improve home energy efficiency.

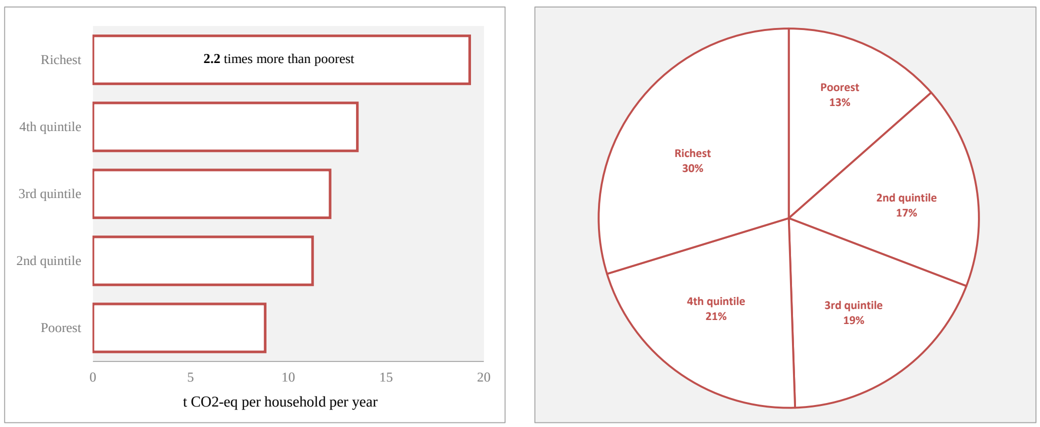
Source: adapted from the Green Housing Forum, 2014

Low-income households have the lowest energy consumption and GHG emissions:

Higher income households are responsible for a disproportionate share of total GHG emissions from home energy consumption. In 2012 the use of electricity, natural gas, and other fuels in Alberta homes produced approximately 18.2 Mt $CO_{2\text{-equivalent}}$ (see Figure 3). The richest 20 per cent of households (highest income quintile) in the province are responsible for about 30 percent of these emissions; the poorest 20 per cent of households (lowest income quintile) account for about 13 per cent. The average household in the highest income quintile produces 2.2 times (or nearly 10 t $CO_{2\text{-equivalent}}$) more GHGs annually than the average household in the lowest income quintile.

Figure 3: GHG Emissions from Home Energy Use in Alberta in 2012, by Income Quintile

(a) Annual GHG emissions from home energy use in Alberta in 2012 | (b) Share of total GHG emissions from home energy use in Alberta in 2012 (18.2 Mt $CO_{2\text{-eq}}$)



Source: Author's own calculations

Low-income households contribute proportionally more towards policy costs:

Since 2000, average energy prices (for electricity, natural gas, fuel oil, and other home fuels) in Alberta have increased 1.6 times faster than a composite of all other consumer goods and services. Over the long-term, energy prices will likely continue to be driven up by world markets. To reduce GHG emissions from the energy system and achieve more stringent targets in Alberta, energy prices need to rise further through policies that internalize the costs of GHG emissions. If, for instance, government policies produced an average carbon price of $30 per tonne $CO_{2\text{-equivalent}}$ for fossil fuel use, the price of natural gas would increase by about $1.50 per GJ—assuming energy suppliers passed on the charge in full to consumers. Similarly, the price of electricity would increase by up to 2.2 cents per kWh. Higher, and increasing, prices for fossil fuels are necessary to spur the investment in home energy efficiency and zero- and low-carbon energy sources necessary to realize significant reductions in emissions from the residential sector. To achieve the GHG reduction target for 2050 in the 2008 Climate Change Strategy, for instance, residential natural gas and electricity prices in Alberta were forecast to rise by about 30 per cent and 22 per cent, respectively, relative to business-as-usual levels.

Distributional impacts of a $30 per tonne $CO_{2\text{-equivalent}}$ charge on fossil fuel use:

Approximate increase in annual energy bill for the average household in each income quintile:

Poorest 20%	$180
2nd quintile	$250
3rd quintile	$290
4th quintile	$380
Richest 20%	$510

Percentage reduction in the disposable income (basic income, plus transfers, less income tax, less housing costs) of the average household in each income quintile:

Poorest 20%	1.7%
2nd quintile	0.8%
3rd quintile	0.6%
4th quintile	0.4%
Richest 20%	0.3%

Source: Author's own calculations

Other things being equal, climate change policies that increase energy prices will have a larger proportional impact on poorer households than richer households. If a carbon price of $30 per tonne $CO_{2\text{-equivalent}}$ was internalized into the price of fossil fuels today, the annual home energy bill of an average household in the lowest income quintile would rise by about $180, after allowing for a reduced natural gas and electricity use in response to the price increase. The annual home energy bill of an average household in the richest income quintile would increase significantly more, by about $510. Yet, the impact of the policy on the disposable income of households is much larger for the average household in the lowest income quintile (whose disposable income declines by about 1.7 per cent) than for the average household in the highest income quintile (whose disposable income declines by about 0.3 per cent). The policy is thus highly regressive—on its own! In reality, the impact on any particular households will depend greatly on whether they can benefit from any energy savings or renewable energy measures.

Indeed, over time, policy-makers will expect energy bills to come down relative to what they would otherwise have been, as energy efficiency improvements and renewable energy technologies in the home spurred by higher energy prices reduce our consumption of natural gas and electricity. But this assumes that all households will have equal access to energy saving and renewable energy measures and related government programs—this is not the case for low-income households (see below).

How will an updated climate change policy in Alberta affect financially disadvantaged households experiencing energy poverty?

Furthermore, as policy-makers consider options to fund more residential energy efficiency programs, it is worth noting that how they are financed can also have important distributional implications for low-income households. Consider, for example, a $90-million dollar per annum program for households (roughly equivalent to the often-cited required annual expenditure of $24 per person). One option to fund a program of this scale is through a uniform surcharge on natural gas and electricity rates paid by all customers. Allowing for the demand response of the rate increase, the surcharge would increase the energy bill of an average household in the lowest income quintile by about $35 per year. The energy bill of an average household in the richest income quintile would increase by about $100 per year. In total, about $10 million of the $90 million program costs would be recovered from the poorest 20 per cent of households in Alberta, with about $30 million recovered from the richest 20 per cent of households.

A $35 increase in the annual energy bill of the poorest households will, nevertheless, represent a much higher proportion of that household's disposable income than is the case for a $100 increase in the bill of the richest households. Funding home energy efficiency programs through a uniform surcharge on natural gas and electricity rates is thus regressive and unfairly penalizes financially-disadvantaged households. It does seem perverse that, in order to alleviate energy poverty and curb growth in GHG emissions, the very households struggling to achieve affordable warmth are required to make a disproportionate contribution to the solution. The most equitable and progressive means of funding a home energy efficiency program is actually through general taxation.

How can we design climate change policies and funding mechanisms to mitigate potential regressive impacts and protect low-income households?

Distributional impacts of a $90 million ($24 per person) per annum home energy efficiency program:

Approximate increase in annual energy bill for the average household in each income quintile in order to recover the costs of the program through a uniform surcharge on natural gas and electricity rates:

Poorest 20%	$35
2nd quintile	$50
3rd quintile	$55
4th quintile	$70
Richest 20%	$100

Percentage reduction in the disposable income (basic income, plus transfers, less income tax, less housing costs) of the average household in each income quintile:

Poorest 20%	0.31%
2nd quintile	0.16%
3rd quintile	0.11%
4th quintile	0.09%
Richest 20%	0.06%

Source: Author's own calculations

Low-income households benefit the least from home energy efficiency programs:

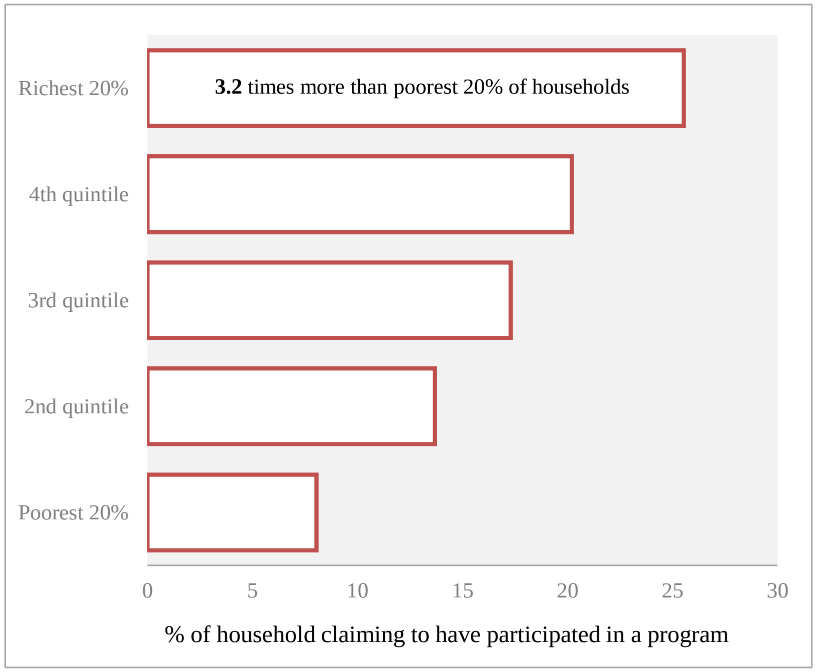
The potential inequitable impacts highlighted above are exacerbated if the poorest households lack equal access to the potential benefits of climate change mitigation policies. Regressive impacts on the poorest households in Alberta can be offset—in principle—by the introduction of energy efficiency programs targeted, at least in part, at the most financial disadvantaged and energy-poor households. These households will almost certainly be unable to improve the energy efficiency of their homes without substantial support. However, simply offering traditional energy efficiency programs is not a solution, as the same households face many unique barriers to participation—primarily, they have no financial means to even partially pay for home envelope or equipment upgrades. Past programs offered in Alberta typically required households to pay the up-front costs of eligible upgrades (some costing thousands of dollars) and then reimbursed them for a fraction of the purchase and installation costs, typically 10-50 per cent. Low-income and energy poor households need much higher levels of cost subsidy or even full subsidization if they are to improve the energy efficiency of their homes. Also, the subsidy needs to be provided *ex ante* (e.g., direct install as part of a free home energy assessment) and not *ex post* (e.g., in the form of a mail-in rebate).

Besides limited or no access to capital, there are several other unique factors that limit the access of the poorest households to energy efficiency programs, including: language and cultural barriers, literacy, access to media, illness and disability. As a result, low-income and energy-poor households do not always identify themselves to take-up the support and energy saving measures that are available.

Evidence from an energy use survey of 3,000 households in Alberta supports the presence and significance of these barriers. The survey found that participation in government energy efficiency programs among the richest 20 per cent of households was about 3.2 times higher than among the poorest 20 per cent of households—at 26 per cent versus 8 per cent (see Figure 4). Consequently, one could argue that much of the available funding went to households who do not really need the help, who are able to pay for eligible energy saving measures themselves, and likely would have done so in the absence of financial support via the programs.

How can we design effective energy efficiency programs for energy-poor households? What practical approaches can be used to better target the most financially disadvantaged households?

Figure 4: Participation in Federal, Provincial or Municipal Energy Efficiency Programs by Households in Alberta, by Income Quintile



Source: C3 Energy Use Survey of Alberta Households, December 2011

4 Solutions to Energy Poverty

The Main Drivers of Energy Poverty

Whether or not (and to what extent) a household is energy poor is determined by the interplay across three core variables—namely:[6]

- Energy prices:
- Dwelling energy efficiency; and
- Household income.

Energy poverty is caused by a combination of three variables:

- Household incomes;
- Home energy prices; and
- Dwelling energy efficiency.

The energy efficiency of a dwelling determines how much natural gas and electricity is needed to adequately heat it and provide other energy services, which in combination with applicable energy prices determines home energy costs. The ability of residents to afford those costs is determined by household income.[7]

The interplay between these variables is evident from the formula for the energy poverty ratio given in Box 1. For instance, if a household's income remained unchanged, then a household may be taken out of energy poverty (or made less energy poor) as a result of:

a. A decrease in energy prices;

[6] Other determinants include: the outside air temperature; the attitudes and habits of household members in relation to heating, the use of rooms, wearing of indoor clothing, etc.; and warmth requirements related to specific health needs.

[7] It is worth noting that low-income by itself does not determine whether a household is energy poor. A low-income family in an energy-efficient dwelling may not be energy poor even though a family on the same income in a similar, but energy-inefficient dwelling would be. As a result of the interaction with the energy efficiency characteristics of the dwelling, the level of income required to ensure that a family is not energy poor varies.

b. An improvement in the energy efficiency of the dwelling; or

c. A combination of both.

The opposite is true if energy prices were to increase or the energy efficiency of the dwelling were to deteriorate. Similarly, if the energy efficiency of a dwelling remains unchanged, then a household may be taken out of energy poverty (or made less energy poor) as a result of:

a. An increase in household income;

b. A decrease in energy prices; or

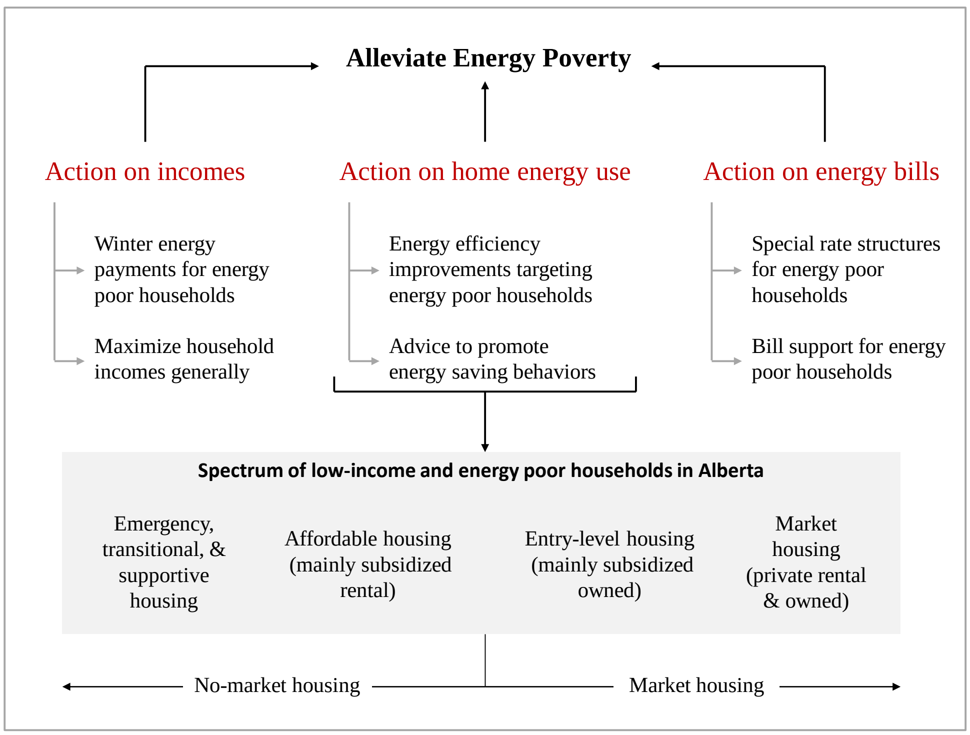
c. A combination of both.

Again, the opposite is true if household incomes were to decrease or energy prices were to increase.

"…there is no realistic substitute for investing in high levels of energy efficiency if fuel poverty is to be eradicated."

[Boardman, 2010]

Figure 5: Main Interventions to Lift Households out of Energy Poverty



Policy Toolkit

Looked at generally, and assuming changes in only one variable, the number of energy-poor households (or the depth of their energy poverty) can be reduced if:

a. The incomes of energy-poor households are increased;

b. Energy prices paid by energy-poor households are decreased (or energy bills are reduced); or

c. The energy efficiency of energy-poor dwellings is improved.

These provide the basis for a policy toolkit to tackle energy poverty. Government, market actors and the voluntary sector can, in principle, intervene to affect each of the core variables. Moreover, a range of possible actions can be taken with respect to each variable. Examples are presented below and in Figure 5. Note that no attempt is made herein to appraise the relative strengths and weaknesses of the actions.

"[Compared to actions on energy prices and incomes] *in the long-term measures to improve home energy efficiency and heating systems will make a more sustained difference to a household's ability to heat their home affordably*".

[DECC, 2011]

"*…policies that improve the thermal efficiency of dwellings tend to be more cost effective for addressing fuel poverty compared to policies that are focused on subsidizing energy costs or increasing incomes.*"

[Hills, 2012]

Action on energy bills:

Potential actions to reduce the bills faced by energy-poor households include:

- Creating specific rate designs for qualifying low-income customers, for example, lifeline rates or inverted block rates. With the former, the rates charged energy-poor households would be, say, 50 per cent of the standard rates. With inverted (or rising) block rates, the initial block of consumption (up to a threshold) is charged at a lower rate than the subsequent block (beyond the threshold). As a result, the price of energy rises with consumption. This means that energy-poor households, with typically lower than average energy use, are likely to see a reduction in energy bills.
- Establishing a separate rate class and rate for qualifying energy-poor households, as opposed to retaining the same rate structure and simply redesigning the rates (as per above). A separate rate class would distinguish energy-poor households from other residential customers, who would continue with the same rate structure.
- Providing bill support directly to eligible households (e.g., low-income households residing in energy-inefficient dwellings), typically in the form of discounts or waivers in respect of fixed charges, commodity charges, or service charges. These may be offered during winter months only or throughout the year. Such forms of support are automatically available to eligible households, on a recurring basis. Energy bill support may also take the form of emergency financial assistance, whereby eligible households experiencing 'unusual' hardship (e.g., unexpected disruption to income, illness or family crisis) may apply for a temporary one-off grant to put towards their bill. Action to support the bills of energy-poor households can be funded and administered by government, market actors, the voluntary sector, or all three collaboratively.[8] Conditions could also be imposed on the receipt of bill support—e.g., the household must allow an energy assessment of their dwelling followed by the installation of desirable energy-saving measures.
- Offering energy-poor households more flexible and tailored customer service and bill payment arrangements. For example, qualifying customers may be allowed to pay their annual bill in equal payments spread evenly throughout the year, with the amounts due directly debited from customer bank accounts. Rules governing (re)disconnections, security deposits, and the collection of bills in arrears can also be adjusted to reduce stress on low-income households.

Action on incomes:

The incomes of energy-poor households can be improved either through particular actions targeted at specific groups, for example, one-off payments to eligible households, or through wider macro-economic improvements that reduce unemployment or increase income levels generally. Indeed, the incomes of low-income households are influenced most by:

- Levels of employment and income from work (for those of working age); and
- Levels of benefits and their take-up by those entitled to them.

[8] Note that these payments are deducted from energy bills rather than added to incomes when calculating the energy poverty ratio.

The first is, of course, an ongoing major policy theme for government. Importantly, to raise incomes of the poorest households in the province, a stronger economy must also be accompanied by increased emphasis on redistributive policies.

The importance of benefit payments is evident when one considers that government transfers accounted for about 45 per cent of the after-tax total income of the poorest 20 per cent of households in Alberta in 2011-12. In reality, the contribution of government transfers to the incomes of energy-poor households is likely higher due to under-claiming of entitled benefits. In 2014, for instance, Public Works Canada said it was sitting on a stockpile of more than $730 million in unclaimed tax refunds and pension, employment insurance and child-tax benefit payments (Marowits, 2014). There are various reasons why benefits may remain unclaimed, including:

- Lack of awareness of the benefits available and the absence of networks to inform potential claimants of benefit entitlements;
- Difficulty with self-identification of eligibility for benefits; and
- The perceived or actual complexity of the benefits system and the claiming process.

A possible solution is to ensure that households who seek help or advice related to energy poverty are encouraged to claim their full benefit entitlement. For example, a “benefit health check” (a survey to ensure people claim all the financial support they are entitled to) could be delivered in tandem with participation in a home energy efficiency program.

The other main way by which the incomes of energy-poor households can be bolstered is through one-off payments that specifically target these households. Examples include:[9]

- A one-off payment made to eligible households at the onset of winter when home energy bills are highest; and
- Top-up payments made to eligible households during prolonged cold spells (e.g., if the temperature is predicted to fall below a specified level for a defined number of days).

The latter functions as an emergency payment to help households heat their homes during periods of extreme cold. The payments are typically made directly to households. If the payments are well-targeted they will provide temporary relief to the energy poor. Ideally, they should be means-tested (e.g., eligible households would include those already entitled to income-related benefits) *and* target ‘high cost’ households.

Action on home energy use:

The final set of actions to take households out of energy poverty focus on reducing energy use within the home. There are a wide range of activities and programs that can reduce energy costs through reduced consumption. In general, they encompass both:

- The installation of energy efficient measures in the home—i.e., technologies (e.g., duct sealing, additional insulation or high-efficiency furnaces) that reduce the amount of energy used to provide a given level of energy service (e.g., a desired level of thermal comfort); and
- The provision of advice to help members of the household use less energy by changing their behaviour (e.g., not leaving windows open in winter to improve ventilation, turning off lights in rooms not in use, ensuring the refrigerator is set at the recommended temperature, etc.). Advice can also extend to the proper use and

[9] Note that these payments are added to incomes rather than deducted from energy bills when calculating the energy poverty ratio.

maintenance of the technologies provided—in particular, programmable thermostats or smart meters—and helping people understand the benefits of energy efficiency and conservation behaviours.

To be effective in addressing energy poverty, programs providing these elements need to be precisely targeted to, and specially designed for, energy-poor households. Targeting is discussed further below. In terms of design, programs should be developed with the following principles in mind:

- The intake process should be extremely simple, accessible, and free to households;
- There should be multiple entry points, facilitated by a collaborative and coordinated approach across government departments and agencies, energy utilities, health and social care professionals, social housing providers, and the voluntary sector;
- The program should employ a 'direct install' format—comprising energy saving technologies that are purchased and installed at no charge to the energy-poor household. It should include both 'basic' upgrades (e.g., weather stripping, door sweeps, pipe wrap, programmable thermostats, low-flow faucets and showerheads, energy efficient light bulbs, etc.) and 'deep' upgrades (e.g., enhanced attic, ceiling and wall insulation, high efficiency furnaces, water heaters, windows and appliances, low-flow toilets, solar water heaters, etc.).[10] During an initial home visit, and with the agreement of the occupant, basic upgrades would be installed, a home energy assessment performed, and information and advice provided. Depending on the home energy assessment, deeper upgrades would be offered, to be installed during a subsequent home visit(s). Emphasis would be placed on deep upgrades that improve the thermal efficiency and comfort of the dwelling. In larger owner-occupied homes, upgrades should target the most frequently used areas of the home—especially if budgets are limited;
- Promotional and education materials should, ideally, be available in languages other than English; and
- Advice on energy conservation behaviours should be offered in tandem with information and advice relating to budgeting and money management (e.g., including advice on tax and benefit entitlements) and how to get on the best energy tariffs.

It is also important that energy efficiency and conservation actions are available to all segments of the low-income housing spectrum—providers and occupants of assisted and affordable housing, owners of privately owned (single- and multi-family) buildings that have low-income tenants, whether or not the tenants are (wholly or partially) responsible for paying their energy bills, and private homeowners.

An example of a small, yet scalable local energy efficiency program for vulnerable seniors in Calgary (Energy Angels) is outlined in Box 2. An energy efficiency and renewable energy demonstration project for a low-rise, multi-family affordable housing building in Calgary is summarized in Box 3. Examples of low-income energy efficiency and conservation programs offered elsewhere in Canada are provided in Box 4.

To illustrate the potential economic and environmental impacts of programs targeting low-income households in Alberta, C3's energy-economic-environmental model of Alberta's

To illustrate the potential economic and environmental impacts of programs targeting low-income households in Alberta, C3's energy-economic-environmental model of Alberta's building stock has been used to simulate two sample programs:

Key assumptions underpinning **Program 1** include:

- Eligible participants are households who are at or below Statistics Canada's before-tax low income cut-off (LICO);
- It is open to both owner-occupied and rental dwellings, across all vintages of single-family and multi-family homes;
- It will commence in 2015 and run through 2025. Participation in 2015 is assumed to be 2% of eligible households. The participation rate is assumed to increase at 10% per year, reaching 5.7% of eligible households per year by 2025;
- Participating households face no costs; and
- It offers basic upgrades, installed during an initial home visit, which also includes a free home energy assessment.

Key assumptions underpinning **Program 2** that differ from Program 1 include:

- It offers a mix of basic upgrades and deep upgrades (installed in 20% of dwellings), with the latter installed during a second home visit.

[10] Basic upgrades are inexpensive and easy to install, and require no formal energy assessment. Extended upgrades, in contrast, are more expensive and complex to install. The selection of extended upgrades for a dwelling is usually based on a formal energy assessment. Installation also requires specialized training. Extended upgrades do, however, provide greater energy savings.

building stock has been used to simulate two sample programs. The results are summarized in the margin.

Program 1:

38,100 dwellings

Total participation by 2025

$25 million

Value of grants disbursed

$8 million

Education and advice costs

$8 million

Admin and overheard costs

$41 million

Total program budget

$101 million

Undiscounted energy savings

$47 million

Social net present value

Negative $70 per t $CO_{2\text{-eq}}$

Average abatement cost

9.7 PJ

Lifetime natural gas savings

225 GWh

Lifetime electricity savings

0.6 Mt $CO_{2\text{-eq}}$

Lifetime GHG savings

Note: the social net present value includes the dollar value of GHG emissions avoided

Are there any innovative energy efficiency and conservation initiatives deployed at the local level in other jurisdictions that could be adapted for application in Alberta?

What mechanisms could be used to improve the interaction between the provincial government, municipal government, utilities, health and social care professionals, the voluntary sector, and the general public in relation to energy efficiency and conservation and energy poverty?

What role, if any, can renewable energy technology play in helping to reduce energy poverty across the different types of non-market and market housing?

Elements of an Effective Strategy to Tackle Energy Poverty

While interventions to enhance incomes and lower energy bills can contribute to the eradication of energy poverty, it is actions to reduce home energy use (specifically, improvements to the energy efficiency of low-income dwellings) that are the most sustainable—i.e., provide long-term reductions in the number of households in energy poverty. The reasons for this are obvious:

- An improvement in the energy efficiency of a dwelling will, by its capital nature, have a permanent (or at least very long-term) effect; and
- The improvement, by the nature of its durable, long-term effect, will protect both current and future (prospective energy poor) residents from energy price rises or reductions in income.

Furthermore, in contrast with actions to increase incomes or reduce energy prices, only energy efficiency improvements contribute to climate change mitigation goals.

A cost-effective and sustainable strategy to tackle energy poverty in Alberta—through the transition to a low-carbon economy—should therefore have at its core three elements:

- As a priority, action to increase the energy efficiency of energy-poor households over time, starting with those most in need (i.e., households in severe or extreme energy poverty, or at greatest risk to adverse health and social impacts);
- The provision of advice and tools to enable behavioural change to reduce energy wastage, especially in households with relatively high energy consumption. Advice should also cover • budgeting and money management, • income maximization by ensuring people claim all the financial support to which they are entitled and • how to select the best energy tariff; and
- For those households still unable to afford satisfactory energy services, the continued provision of financial support to reduce energy bills (e.g., the payment of an energy bill rebate, emergency financial assistance). Energy efficiency and conservation actions are unlikely to reach the number of households needed, in the time required. Moreover, in cases of unusual hardship, some households will need financial support with their bills, despite having received such actions—though the payments offered may be lower than they otherwise would have been. In the

longer-term, the need for energy bill support will generally decline, as increasingly more dwellings of the most energy-poor households are upgraded.

The effectiveness of such a strategy depends crucially on precise targeting of the interventions, making maximum use of available information.

Program 2:

38,100 dwellings

Total participation by 2025

$59 million

Value of grants disbursed

$8 million

Education and advice costs

$17 million

Admin and overheard costs

$84 million

Total program budget

$190 million

Undiscounted energy savings

$84 million

Social net present value

Negative $60 per t $CO_{2\text{-eq}}$

Average abatement cost

19.5 PJ

Lifetime natural gas savings

345 GWh

Lifetime electricity savings

1.2 Mt $CO_{2\text{-eq}}$

Lifetime GHG savings

What is the optimal mix of actions on incomes, energy bills, and home energy use to reduce energy poverty in Alberta? Who should develop, coordinate, and deliver these actions? How should they be financed?

Targeting Issues

A major problem with energy efficiency and conservation programs in the context of energy poverty has been accurate targeting of households in need of support (and especially vulnerable households with members over 60 years old, young children, long-term disability or chronic illness).[11] Low-income households do not often identify themselves to take up the support that is available. And for government, market actors or voluntary organizations to accurately target actions, they need detailed information about both household incomes and energy costs.

If funding and resources inadvertently go to households who do not need it (e.g., low-income households residing in low-cost energy efficient homes), the overall cost-effectiveness of a strategy to reduce energy poverty will suffer and goals will not be met. In general, there is a trade-off between traditional, cheaper to administer but less well targeted (and less impactful) low-income programs, and programs that are better targeted at the most vulnerable households and thus more impactful, but are more expensive to administer. In addition to the benefit proxies (e.g., means-tested payments or tax-credits) often used to define eligibility for low-income energy assistance programs, policy-makers can now look to a number of novel approaches to more accurately target energy-poor households, and specific groups of these households. A few examples are outlined below.

A role for health and social care and professionals:

General practice doctors (GPs) and other healthcare and social services professionals are very familiar with the communities they serve—and generally have the trust of their patients and clients. They are therefore well placed to identify energy-poor individuals and families by being alert to their social circumstances and patterns of illness with known links to energy poverty. GPs, for example, can use patient records and professional knowledge to pinpoint patients living in cold or hard to heat homes, or who are particularly vulnerable due to their medical circumstances. Indeed, some local healthcare trusts in the UK are piloting schemes whereby GPs are provided with an IT tool that enables them to refer vulnerable patients to local energy efficiency and conservation programs. Some pilots also link with voluntary and community organizations to provide both home safety checks and free repairs, as well as advice on income maximization.

Guidance and ongoing training would need to be developed for frontline health and social care professionals so they can confidently identify and respond to the needs of those in energy poverty. While they do not need to be experts on energy efficiency or the benefits

[11] As shown in Figure 4, historically, the poorest 20 per cent of households in Alberta are 70 per cent less likely than the richest 20 per cent of households to participate in government energy efficiency programs.

system, they should nonetheless be able to integrate energy poverty vulnerability into their daily assessment and care of patients and clients—enabling them to discern someone who is living in an inadequately-heated home, provide advice on what they can do to keep warm, and refer the most vulnerable individuals to schemes were they can access benefits advice and energy efficiency and conservation programs offered by government, market actors, or the voluntary sector.

Area-based approaches and thermal imaging:

Aerial thermal imaging of known low-income neighborhoods may also be used to identify homes in need of energy efficiency measures. Targeting is further improved if the imaging is combined with other data sets to enable the identification of specific low income dwellings or groups of dwellings at the post code level. For example, benefits data could be cross-referenced with the worst performing dwellings on the thermal imaging map, with these households then given information on grants for energy efficiency upgrades and advice.

A few important issues have nonetheless been raised during pilots of thermal imaging—e.g., the imaging provides only a snapshot at one moment in time and can be affected by factors such as whether the occupants were at home or the heating was turned at the time of the survey.

Data-matching:

Another approach to improve the targeting of energy-poor households, and specific groups of these households, involves using data-matching techniques. This comprises the development of coordinated systems to match and share data between different government departments and agencies, market actors, and voluntary organizations. The example above is a form of data-matching, where the relevant government agency shares benefits data with a municipality which undertook the thermal imaging of low-income neighborhoods, defined on the basis of census data from Statistics Canada. A further simple example would involve the same government agency sharing benefits data with utilities to match with energy consumption data. Data-matching is particularly useful when trying to identify core groups of vulnerable energy-poor households.

"*Health professionals have the most contact with vulnerable people, and are often the most trusted confidants and advisors of isolated, old people*. […] *Involving health care professionals therefore provides the opportunity to target* [energy efficiency and conservation] *programs to those most in need and most likely to benefit, but who are unlikely to apply on their own*."

[Olsen, 2003]

A final point worth making in the context of targeting energy-poor households, is the fact that a significant number of households move in and out of income poverty or financial hardship relatively quickly. Hence, whatever targeting approach is used, it needs to be flexible and capable of determining relatively quickly when households are unable to afford adequate energy services, and when they move in and out of that situation.

Which groups of energy-poor households should be targeted first?

How should actions be targeted (e.g., benefits proxies versus area- or neighborhood-based versus approaches to 'pin-point' actions)?

What innovative approaches for targeting energy-poor households, and sub-groups of these households, used in other jurisdictions, could be adapted for application in Alberta?

Box 2: Energy Angels Program for Vulnerable Seniors in Calgary

Energy Angels is a partnership between All One Sky Foundation and The City of Calgary Seniors Services to provide basic weatherization and energy efficiency upgrades to low-income seniors in privately owned, single family homes. Over the past two years, the program has reached about 50 eligible, low-income homes per year. The City provides administrative eligibility for qualifying households and an installation crew. It operates a skills training program for underemployed people, who work with the installation crew over a six-week period.

The team installs water-efficient faucets and shower heads, weather stripping, window vinyl, CFL light bulbs and occasionally, new doors. All One Sky Foundation raises funds for equipment and materials through community groups, corporations and individuals. The installations result in an average annual utility savings of $260 per household. Seniors Services has now incorporated the installation of energy efficiency upgrades into its business plan for its low-income clientele.

Box 3: Affordable Housing Case Example: Bankview Energy Efficiency Demonstration Project

The Calgary Housing Corporation (CHC) is in the midst of a capital investment program to renew the buildings it manages. Using one of the buildings scheduled for refurbishment in 2014 as a case study, the main objectives of this project were:

- To prove the business case for using comprehensive ('whole building') energy efficiency improvements to (a) reduce the energy burdens faced by low-income households, (b) free-up funds for property owners to refurbish and extend the life of more buildings, and (c) reduce GHG emissions cost-effectively;
- To create a replicable approach for performing 'whole building' energy efficiency improvements of affordable housing properties;
- To develop a modelling tool to support application of the replicable approach in practice; and
- To form partnerships between social service and affordable housing agencies and the energy management and GHG mitigation community.

The replicable approach for performing 'whole building' energy efficiency improvements developed during the project comprises seven tasks:

1. **Select the building(s) for investigation**

The reality is that most owners and managers of affordable housing will have limited financial resources. To maximize the contribution of energy efficiency improvements to reducing the energy burdens faced by low-income households for a given level of spend, a number of factors should be considered when selecting sites (e.g., age and energy efficiency of building, past refurbishments or upgrades, unit size, nature or existing capital renewal plan, whether the tenant pays utility bills, etc.). Bearing these factors in mind, a CHC property in the community of Bankview scheduled for refurbishment in 2014 was selected as a case study.

The case study building is a low-rise apartment block constructed in 1982. It has a gross conditioned area of 28,312 ft^2 (2,630 m^2), including the underground parkade with 18 vehicle stalls. There are 26 separate apartments, including 3 in the basement level, each with street-level entry, and 23 units in the three above-ground storeys. Residential suites are individually metered for electricity, but not for natural gas. Residents are obliged to have private contracts for electricity supply, and the CHC divides the natural gas bill based on the floor area of each suite.

The building is in reasonably good condition for its age and the energy consumption is in the middle of the range for similar building types of this vintage.

2. **Review the existing capital refurbishment program for the selected building(s)**

For deep energy efficiency upgrades to be most cost-effective, the upgrades need to be aligned and integrated with planned building refurbishments and equipment replacement. A key task is thus to review the existing refurbishment plan for the building, and in particular identify planned upgrades that will have implications for energy use. The focus of the business case is the incremental cost of energy efficiency improvements and the associated incremental energy savings that are additional to the planned capital refurbishments for the building.

The existing capital renewal plan for the case study building includes upgrading the insulation in the north and south walls, and replacing all windows and exterior steel doors with moderately more efficient units. These upgrades define the project *Reference Case* against which additional energy efficiency improvements to the building are appraised. Analytically, the situation that could exist following the installation of any additional improvements to the *Reference Case* defines the *Low Carbon Case*, while the situation that exists prior to the existing planned upgrades defines the project *Base Case*.

3. **Undertake energy (audit) assessment**

The third task involved identifying where, and how much, energy is consumed in the building. To this end, an energy audit of the building was conducted in May 2014, including infra-red imaging to identify areas of heat loss. The audit summarized energy use by different systems at the site under *Base Case* conditions. In 2013, for example, energy consumption amounted to 2,169 GJ of natural gas and 47,620 kWh of electricity (excluding electricity use in the rental units which was estimated from sample tenant bills at 282 kWh per day per unit.) Potable water consumption at the building was estimated at 6,505 liters per day. The information provided by the audit and the infra-red imaging served as a basis for the development of an energy simulation model for the building.

4. **Build energy simulation model and calibrate to Base Case**

Buildings are like systems. They comprise many materials and components which work together to determine overall energy use. Evaluating energy efficiency improvements in isolation of each other, and without accounting for external factors (e.g., exposure to sunlight, humidity, and external temperature) will likely (over)understate actual savings and costs. When appraising ‘whole building’ energy efficiency upgrades it is thus necessary to use a computer simulation model to capture interactions between building components and the influence of external factors. Using architectural, mechanical, and electrical drawings provided by the CHC, a comprehensive energy simulation model of the case study building was developed in the Hot2000 software—a free software package available from Natural Resources Canada. The model was constructed to reflect *Base Case* conditions and calibrated to match monthly utility bills averaged over the past three years. With the model calibrated to the actual utility billing data, the *Reference Case* and *Low Carbon Case* could be simulated with reasonable confidence.

Whole building energy consumption (including electricity use in rental units) under the project *Base Case* is 2,598 GJ. The corresponding GHG emissions are 205 t CO2-eq per year. Whole building energy consumption under the project *Reference Case*, which includes three planned improvements to the building envelope, is 2,402 GJ. The corresponding GHG emissions are about 5 per cent lower than the project *Base Case*—at 195 t CO2-eq per year.

5. **Identify additional energy saving and renewable energy opportunities**

The next task involves identifying energy savings and renewable energy opportunities additional to those in the project *Reference Case*. In total, twenty-two potential energy efficiency upgrades (encompassing windows, doors, lighting, wall insulation, deck insulation, roof insulation, draft proofing, heating controls, boilers, water heaters, appliances, laundry facilities, and water use in rental units) and two renewable energy projects (solar thermal hot water and solar PV power) were identified.

6. **Identify additional energy saving and renewable energy opportunities**

The penultimate task consists of, first, evaluating the financial and environmental performance of each identified energy saving opportunity, and second, to create and evaluate portfolios of opportunities for the case study building. Energy saving opportunities and portfolios are appraised on the basis of incremental discounted cash flows, where:

Energy savings = Discounted lifetime energy use at building under project *Reference Case* less discounted lifetime energy use at building with energy saving opportunity installed under project *Low Carbon Case*; and

Costs = Discounted lifetime costs (capital and annual O&M costs, net of available financial incentives) of implemented energy saving opportunities less discounted lifetime costs of *Reference Case* upgrades. Costs are defined to reflect the full price paid by the property owner, including equipment costs, material costs, labor costs, and overhead and profit.

Water savings and reductions in GHG emissions are similarly defined. Opportunities were appraised using a variety of standard financial decision criteria, including Net Present Value (NPV). The analysis was performed using a Financial Decision Support Tool developed as part of the project, and was conducted from two perspectives: (1) **private** (benefits include the dollar value of lifetime utility bill reductions only); and (2) **public** (in addition to private benefits, the dollar value of lifetime damages avoided from GHG emissions is included).

Four portfolios of energy savings opportunities were constructed: (1) Low Carbon Case Max (**LCC-Max**) which maximizes lifetime GHG emission reductions, regardless of costs; (2) **LCC-Private** which maximizes the NPV of utility bill savings to property owners or managers; (3) **LCC-Public** which maximizes the NPV of (2) plus avoided damages from GHG emissions; and (4) **LCC-Social** which maximizes the NPV of (3) plus a credit for the non-energy benefits to low-income residents.

	LCC-Max	LCC-Private	LCC-Public	LCC-Social
Total energy saving projects	19	10	12	13
Investment costs	$434 900	$159 500	$197 200	$237 800
Lifetime energy savings	$613 700	$416 900	$475 900	$525 800
Lifetime water savings	$116 200	$116 200	$116 200	$116 200
Average annual utility bill savings	$18 200	$13 300	$14 800	$16 100
Lifetime GHG emission savings	2 710 t CO_2-e	1 610 t CO_2-e	1 955 t CO_2-e	2 250 t CO_2-e
Reduction from Reference Case	41%	26%	31%	35%
NPV (private perspective)	-$72 900	+$107 200	+$97 800	+$81 700
NPV (public perspective)	+$10 600	+$157 300	+$158 300	+$151 200

7. **Formulate and present recommendations**

The final task is to formulate a package of recommended energy efficiency, conservation, and renewable energy projects for consideration by the property owner or manager for inclusion within a modified capital renewal program for the building. The recommended portfolio of additional energy saving and renewable energy opportunities—that strikes the best balance between NPV (from both private and public perspectives) and lifetime GHG emission savings—is **LCC-Public**. This portfolio includes:

Installing low-flow faucet aerators in all apartments	Upgrading all windows to achieve R5 and increase window air tightness from CSA A1 to A2
Installing low-flow showerheads in all apartments	Replacing existing electric clothes dryers with natural gas dryers
Weather stripping and air sealing to increase building air tightness from 'loose' to 'average' (4.5 ACH @ 50 Pa)	Upgrading lighting in apartments (full LED package)
Replacing existing communal clothes washing machines with Energy Star qualified appliances	Installing programmable thermostats in all apartments
Upgrading lighting in common areas (T12 to T8, plus CFL to LED)	Installing a solar PV system, 72 panels with PTC rating of 221 W (15.9 kW installed capacity)
Upgrading hot water heaters from existing tanks to condensing units (seeking improvement in efficiency = 30%)	Upgrading all patio doors with Energy Star in-swing French Doors to achieve R 3.85

Annual operating cost savings for the building amount to about $350 per resident, shared between tenants and the CHC. For the average household in the lowest income quintile in Alberta, savings of this magnitude would cover their expenditures on health care for 15 weeks, education for 20 weeks, food for 5 weeks, or recreation for 10 weeks.

Source: Boyd and Brooke (2014)

Box 4: Examples of Low-income Energy Assistance Programs

Most Canadian provinces and territories have some form of low-income energy efficiency assistance. Three provinces, however, have long-standing, well-funded programs worthy of mention.

Manitoba

Manitoba Hydro launched its Power Smart Affordable Energy Program in late 2007, with a $23.1 million fund for energy efficiency upgrades in low-income homes in addition to funding from the utility and regulator. Based on its initial success as a collaborative, community-based program, Manitoba's program features a number of innovative elements:

- Free home evaluation and weatherization upgrades;
- Free insulation including installation;
- Provision for a natural gas furnace for $9.50 per month over 5 years and boiler rebates;
- Landlord/tenant efficiency upgrades;
- First Nations programs;
- Targeted low-income neighborhood canvassing; and
- Local trainees conduct retrofits free of charge.

The program serves about 2,500 participants annually and is funded by the utility through Power Smart investments, the legislated Affordable Energy Fund (Winter Cost Control Heating Act) and the Public Utilities Board regulated Furnace Replacement Fund.

Nova Scotia

Nova Scotia has allocated $37 million over 10 years to upgrade all electrically-heated, low-income homes. There are currently about 29,000 low-income homes in Nova Scotia. To date about 23 per cent of these homes have been retrofitted with energy efficiency upgrades (ranging from basic weatherization to insulation). This leaves 6,600 electrically heated homes and 15,400 non-electrically heated homes to be retrofitted. The long-term plan is to upgrade all the low-income homes for energy efficiency over the next 10 years. Energy efficiency upgrades for low-income houses will result in annual energy savings of about $500 to $900 per household.

The Nova Scotia government funds the non-electric low-income energy efficiency programs through Efficiency Nova Scotia. Nova Scotia Power Inc. covers electrically-heated homes through a charitable donation to the Clean Foundation.

British Columbia

BC Hydro (electricity utility) partners with Fortis BC (gas utility) on two programs:

- Energy savings kits (simple, easy-to-install energy savings products) that can be ordered online and self-installed. Over 150,000 kits have been distributed since 2009.
- Power Smart for Low-Income Households provides low-income account holders with free home evaluations, basic energy-saving technologies, and in some cases insulation, refrigerator and furnace replacements. The program reaches owned or rented single-family homes, duplexes and mobile homes; and has a First Nations outreach component.

The program has an average annual budget of $5.5 million. Like Manitoba, BC has found it needs to find innovative ways to reach low-income clients who may have more pressing concerns, such as health, food and rent. As demand for energy savings kits has slowed, the program is increasingly marketed through food banks, social service agencies and bill inserts.

Where are we now?

Roughly 1-in-6 households in Alberta are energy poor

Where do we want to be?

In a situation where (say) all low-income households achieve affordable warmth and energy services, by some future date

How do we get there?

Increase the energy efficiency of energy-poor households over time, starting with those most in need

Encourage behavioural change to reduce energy wastage

Provide energy bill support to households still not achieving affordable warmth

Did we get there?

5 CREATING A ROAD MAP FOR ALBERTA

Why a Road Map?

Tackling energy poverty clearly offers a potential 'win-win-win' for three important environmental and social policy agendas:

1. Climate change mitigation and GHG emission reductions;
2. Health and well-being; and
3. Poverty alleviation.

To capture these wins, a holistic and long-term strategy for reducing energy poverty is needed for Alberta; roadmaps are an effective tool to achieve this. A roadmap is a detailed strategic plan to guide progress towards a shared vision (outcomes and goals). Without a roadmap, it will be very difficult for government to: decide the best ways to address energy poverty in Alberta; create consensus across departments, market actors and the voluntary sector; and assess the extent to which it is achieving its vision.

Do we need a road map to both guide and coordinate interventions to address energy poverty in Alberta?

To answer this key question, a working group could be formed from experts across relevant government departments and agencies, electricity and natural gas utilities, and voluntary and community-based organizations.

Process of Developing the Road Map

A successful roadmap to tackle energy poverty in Alberta—should the Alberta government opt to go down that route—must contain a long-term vision shared by key stakeholders, related evidenced-based targets and intermediary milestones, followed by a specific pathway for reaching them. In addition, if the roadmap is to be effective, it should include metrics to allow for regular evaluation and renewal to take account of results achieved to date, as well as changes in energy prices, income poverty, energy saving technologies, the energy efficiency of the housing stock, etc.

A generic process for developing an energy poverty roadmap for Alberta is shown in Figure 6. The process consists of four phases:

1. Plan, prepare and initiate the process;
2. Create a shared vision among policy-makers and stakeholders;
3. Develop an evidenced-based roadmap and action plan; and
4. Implement, monitor, evaluate and revise the roadmap.

It also includes two types of activities: ❶ decision-making and consensus building; and ❷ data gathering and analysis. Six to twelve months should be allowed to develop and launch an effective roadmap.

The main output of the roadmap development process is the '**Action Plan**'. This crucial document should do the following:

- Set out the nature of the task to be achieved (i.e., a vision statement articulating the desired outcomes);
- Stipulate a clear set of targets and intermediary milestones, pegged to specific dates, that, if achieved, will result in the desired outcomes;
- Outline relevant obstacles, barriers and gaps in knowledge that must be overcome and how they are to be overcome;
- Describe the range of possible policy measures available to achieve the task over the relevant timelines;
- Make a triple-bottom-line appraisal of those measures and select a package of (priority) measures designed to achieve the targets and intermediary milestones;
- Explain what it will cost to achieve the task, with reference to each of the selected policy measures;
- Put in place adequate finance for all of the measures shown to be necessary;
- Set out clearly which organizations or institutions are responsible for delivery, with reference to each of the selected measures; and
- Explain what will happen if milestones and targets are not reached.

Figure 6: Process for Developing a Road Map to Tackle Energy Poverty in Alberta
(showing decision-making and consensus building in the left column and data gathering and analysis activities in the right column)

Phase 1. Plan, prepare and initiate

- Establish steering group
- Define scope and timing
- Select stakeholders and experts
- Identify lead organization

- Review available evidence
- Identify information gaps
- Commission necessary research
- Establish baseline

Phase 2. Create vision

- Identify long-term vision (desired outcomes and goals) amongst senior policy-makers
- Engage key stakeholders

- Develop and analyze future policy scenarios, reflecting different levels of ambition

Phase 3. Develop roadmap

- Establish expert working groups, by theme
- Identify obstacles and barriers to be overcome
- Develop comprehensive set of needed policy measures
- Engage key stakeholders to agree level of ambition, targets and timelines, and priority measures
- Allocate resources and assign responsibilities

- Triple bottom line analysis of identified policy measures
- Analyze contribution of measures to desired outcomes and goals, individually and as packages, over time

Create **Action Plan** → Consult with stakeholders → Refine and launch

Phase 4. Implement, monitor and evaluate, revise

Who should lead the development of a roadmap to tackle energy poverty in Alberta? Who are the key stakeholders and experts to involve?

Key Questions for a Working Group(s) to Consider

Defining the problem in Alberta

- What constitutes an appropriate measure of income for energy poverty analysis? Should income be measured before or after fixed housing costs? Whether using before or after housing costs, should incomes be equivalized? Which government transfers should be included within income?
- What constitutes a suitable temperature threshold for a 'satisfactory' heating regime in Alberta? Should a different threshold (and demand pattern) be used for the most vulnerable households? Should adjustments be made to energy demand patterns for under-occupied dwellings?
- What are the most appropriate energy prices to use when estimating required energy costs? What is the best source of this information?
- Should the threshold for energy poverty be determined relative to the median energy cost to income ratio for all households, with its value changing over time, or be a fixed, absolute threshold, such as 10 per cent of income?
- Should the cost of water services be added to required energy costs?
- Who are most at risk to energy poverty in Alberta? Who are the severe and extreme energy poor?

Impacts of energy poverty on health and well-being

- Does the evidence in Alberta support the presumption of a link between energy poverty and poor health outcomes, including cardiovascular diseases and respiratory illnesses?
- Who are most at risk to excess winter deaths in Alberta? Does the evidence in Alberta support a link between excess winter deaths and the socio-economic status of these individuals or other indicators of social deprivation?
- Is there evidence of a link between factors associated with energy poverty (living in cold homes, difficulty in paying energy bills) and poor mental health and social outcomes in Alberta? Which groups are most at risk?
- What is the cost burden of energy poverty for Alberta Health Services?

Impacts of the transition to a low-carbon economy

- How will an updated climate change policy in Alberta affect financially disadvantaged households experiencing energy poverty?
- How can we design climate change policies and funding mechanisms to mitigate potential regressive impacts and protect low-income households?
- How can we design effective energy efficiency programs for energy poor households? What practical approaches can be used to better target the most financially disadvantaged households?

Solutions to energy poverty

- Are there any innovative energy efficiency and conservation initiatives deployed at the local level in other jurisdictions that could be adapted for application in Alberta?
- What mechanisms could be used to improve the interaction between the provincial government, municipal government, utilities, health and social care professionals, the voluntary sector, and the general public in relation to energy efficiency and conservation and energy poverty?
- What role, if any, can renewable energy technology play in helping to reduce energy poverty across the different types of non-market and market housing?
- What is the optimal mix of actions on incomes, energy prices and bills, and home energy use to reduce energy poverty in Alberta? Who should develop, coordinate, and deliver these actions. How should they be financed?
- Which groups of energy-poor households should be targeted first by actions?
- How should actions be targeted (e.g., benefits proxies versus area- or neighborhood-based versus approaches to 'pin-point' actions)?
- What innovative approaches for targeting energy-poor households, and sub-groups of these households, used in other jurisdictions, could be adapted for application in Alberta?

Creating a road map to tackle energy poverty in Alberta

- Do we need a road map to both guide and coordinate interventions to address energy poverty in Alberta?
- Who should lead the development of the roadmap? Who are the key stakeholders and experts to involve?

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ALL ONE SKY FOUNDATION is a not-for-profit, charitable organization established in 2010 to help vulnerable populations at the crossroads of energy and climate change. We do this through education, research and community-led programs, focusing our efforts on adaptation to climate change and energy poverty. Our vision is a society in which ALL people can afford the energy they require to live in warm, comfortable homes, in communities that are able to respond and adapt to a changing climate.

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